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and that induction is a mere psychological preliminary, important only in the biography of the individual thinker. I wish that Mr. Buermeyer would turn his well-loaded guns upon that camp; and in conclusion I again thank him for the opportunity to make clearer points which in *How We Think* were doubtless left in regrettable obscurity.

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THE NERVOUS SYSTEM, PSYCHOLOGICAL FACT OR FICTION?

SO habituated have we become to the inferior position which psychology occupies among the sciences that we have become accustomed to excuse its deficiencies rather than to understand and correct them. Hence, the tradition continues that psychology deals with vague and futile materials, not natural facts which can be described and referred to valid laws. Indeed, it is only with extreme reserve that one grants psychology a place among the natural sciences at all. Of course it is the psychologist himself who is responsible for this situation for he is only very slowly prying loose the facts of his domain from the metaphysical incrustations in which the centuries have confined them.

The psychologist's handling of the nervous system is an excellent case in point. The nervous system, originally brought into psychology as a means of concretizing and interpreting the diaphanous and fleeting states of mind, has not yet been provided with its proper place as a component factor in a complex psychological act. Instead, it is mainly used as a scheme wherewith to handle the elusive knowings or awarenesses which are still all too prominent in psychological writings. Although the nervous system is made to do heavy duty in psychology, as is manifest from even the slightest examination of psychological literature, it is only in the case of reflexes and similar actions that it serves in any sense as a descriptive factor. In practically all other cases the nervous system is used in psychology merely as an explanatory agent. In the present paper an attempt is made to investigate the neural conceptions prevalent in psychology with the hope that we can thereby suggest what is factual and what fictitious in these conceptions.

Unfortunately, at present it happens to be true that in general, whether psychologists use the nervous system as a descriptive fact as in the study of reflex action, or as an explanatory instrument in other cases, the results so far as psychology is concerned are

equally detrimental. In general, we might say that two distinct and serious disadvantages are thereby sustained. Not only are the highly important nervous functions gravely misinterpreted, with the consequence that the whole psychological act is hopelessly misunderstood, but, what is probably worse, a barrier is immediately set up preventing future progress in our interpretation of psychological phenomena.

Briefly, let us examine each of the two uses of the nervous apparatus in psychology, and first the descriptive use of it. When we describe a reflex or any other act as a neural apparatus or as an effect of a neural operation we give only a partial description of the activity. Either we make the nervous apparatus the whole act to the exclusion of the muscular, glandular and other processes, as well as the stimulating circumstances, or else, when we include the muscular, glandular, and other response factors, we still exclude the stimulating conditions which are no less essential factors in the whole action. Need we say how inaccurate and useless is the description of an act when we omit from it any factor, whether it is muscular, glandular or discriminative? But we might suggest how seriously inadequate must be an account of a response act from which is omitted the specification of its differential character and specific sensitivity to a particular stimulating object and condition. To omit the recording of the stimulating conditions of reflex and other psychological reactions means to seek exclusively in the reaction phase of the behavior for the mechanism of the event, which in its essence is an interaction of a complete response with a specific stimulus.

That the nervous system should ever have been made into the exclusive materials of a psychological act may be explained by the great influence of histological and experimental findings upon the thinking of psychologists. Truly remarkable, of course, are the coördinating and integrating functions of the nervous apparatus even when considered as purely physiological (mechanical) functions, but just as certain is it that the narration of how allied and antagonistic reflexes operate as mere facts of synaptic coördination gives us a very slight notion of the exact place of the nervous apparatus in a psychological action. We meet here with a paradox, namely, that the over-emphasis of the neural apparatus in psychological descriptions, instead of adding anything to our understanding of the nervous system, rather deprives us of such an understanding, besides inducing us to place a very erroneous interpretation upon the total psychological act. No one can gainsay that experimental work on the nervous system is absolutely indispens-

able for an understanding of psychological reactions, especially of the simpler sort, but to overlook in such experimentation the pragmatic neglect of many other essential factors, means to misconstrue the facts studied. Let us also remember that in all experimental work the necessity to use simple actions in the laboratory procedure results in an emphasis on the neural¹ factors entirely out of proportion to their actual place in psychological behavior in general.

Turning now to the employment of the neural apparatus as an explanatory factor in psychological interpretations, we find that practically always it serves as a means of supporting a theory of behavior not actually derived from the observation of such behavior. In particular the neural mechanisms are used to uphold some sort of mentalism; that is to say, the neural apparatus is seized upon as an appropriate physical counterpart (either parallel, cause, or condition or result) of mental states. Among the conditions presumably explained by the neural apparatus is the manner in which the "psychic," whether conceived as stuff or process, can operate in a factual world. And so the nervous system is taken to be (1) the tangible counterpart of the intangible psychic; or (2) it serves merely to fill in the gaps (subconscious and association theories) between the functioning of mental (awareness) processes; (3) or further, it is made to operate as the complete substitution for consciousness in cases where no awareness is presumed to be present. We will not attempt to rehearse here all of the difficulties attendant upon the confusion of the nervous system with mind, which inevitably results from employing a neural explanation in psychology. Suffice it to say that it is our fundamental conviction that the necessity to look upon the nervous system as an explanatory principle for psychological processes is for the most part owing to a lack of appreciation of the essential fact of psychological phenomena, namely, the interaction of a complex organized specific response with a specific stimulus.

Many are the specific ways in which the nervous system is used in explaining so-called mental facts or awareness, and always, we submit, with hopelessly unsatisfactory results. We take pleasure in availing ourselves of Holt's excellent discussions² of the peculiar interpretations of the neural functions in mental activity. In speaking of the relation of automatic or habitual to so-called con-

¹ We doubt much whether an unbiased judgment would lay greater stress upon the neural factor than upon the glandular or muscular phases, although it seems clear that the interrelationship of response with stimulus would suffer in any such comparison.

² *The Concept of Consciousness*, 1914, Ch. 15. Also this JOURNAL, 1915, Vol. XII, pp. 365-372, 393-409.

scious activities he says, "One theory, for instance, has it that the cerebral cortex is the 'seat of consciousness,' while habituated unconscious acts are done by the cerebellum and cord. From which it follows that when a motion is first learned (for this appears to be always a conscious process) it is learned by the cerebrum, but thereafter it is performed by the cerebellum and cord (which never learned it). A most plausible conception! And thereafter, since it can be performed either consciously or unconsciously, a double set of nervous mechanisms is maintained in readiness. Or again, there is a view that 'consciousness' is comparable to resistance, or heat, developed at neural cell or synapse. Unconsciousness in a process is attained when the neural path is worn so 'smooth' that no appreciable heat is developed. When, then, an act has once become automatic it can not be performed consciously, unless the organism relearns it in a new set of nerves. This patently violates the facts."³ Also, Holt has shown⁴ in his analysis of the drainage theory of McDougall that sometimes the attempt to use the nervous system as an explanation of awareness results in the theory that when the nervous mechanism functions least, there is a maximum of consciousness.

Nor is the case any better with the action theory of Münsterberg which Holt himself espouses, for there has never been, nor can there ever be established any relationship between the nervous system and any kind of knowing. All such neural theories succeed only in throwing the nervous system out of its perspective in the total reaction. No less has this been the case when the nervous apparatus is considered the basis for the association of ideas, than when the neural mechanism is assumed to be a basis for consciousness in general. Indeed, in Holt's article from which we have quoted, we are inclined to believe the spirit of the discussion is opposed to the conception that a psychological act is primarily a neural act or that the activities involved in psychological action are due to and can be explained by the nervous apparatus involved. Holt's view when stripped of its traditional neural concretions is not far from our hypothesis that psychological behavior consists of the stimulating object or conditions on the one hand, and the action of the person on the other. Indeed, wherever Holt uses an illustration, his argument is definitely in accord with our own. We deem it most unfortunate that the neural tradition is so strong, since it induces such aberration in our vision of psychological facts as to prevent us from describing human behavior as it occurs and interpreting it in factual terms.

³ *The Freudian Wish*, 1915, p. 190.

⁴ *The Concept of Consciousness*, p. 334.

We would urge, therefore, that psychology should be emancipated from physiology, for it is only when psychological behavior is studied as it actually occurs that justice can be done to the nervous functions as well as to all the other factors in psychological phenomena. How troublesome the neuron theory is may be judged from the fact that even when psychologists consider that they are studying responses to stimuli the neural prejudice influences them to consider all psychological behavior as merely the integration of reflexes. Two fundamental objections to this procedure may be offered. In the first place, reflex acts belong to the permanent behavior equipment of the individual and are not capable of integration;⁵ and secondly, to think of all of our behavior as reflexes or combinations of reflexes means to overlook the great variety and complexity of our actual behavior. Especially can such a conception not do justice in any sense to the complex social, esthetic, and moral adaptations to our human surroundings. We wonder if anyone ever seriously considered the nervous system as such to be of any service in distinguishing between two objects, to say nothing of a difference between the alternatives of a moral issue. But it is implied that in simpler cases the nervous system does perform such functions. Thus, the supporters of the neuron theory necessarily overlook the presence in the behavior equipment of the person of other very important types of acts besides reflexes, as well as all the other specific facts of human adaptation other than neural action. To deny then, that all of our behavior is reflex in form does not mean in any sense to neglect or deny any quality or value of reflexes, but merely not to ascribe to them qualities they do not have, nor attribute to them vague and mystic properties of becoming something else by concretion and aggregation. For it is inevitable when we make reflexes the basis of every reaction that we introduce surreptitiously and *ad hoc* qualities and conditions which really are not there. An excellent example of this (because in this matter psychologists follow the physiologists) is the case of the physiologists who assume that upon the series of physiological facts which they study there is crudely superimposed another series which they call psychic.

The neuron theory, we submit, stands in the way of psychologists who would develop a concrete science of actual human behavior, for such behavior, it need hardly be argued, is essentially such a complex adaptation to conditions that it is unthinkable that a neural theory could be an explanation of it. Moreover, to cling

⁵ In the psychological process of integration we assume that acts lose their identification in becoming parts of larger acts.

to such a theory means to make the reflex act the prototype of human action. And just here is where the extreme deficiency of the neural theory appears, for by retaining it as a general means of explanation we overlook its actual function and value as a component in all psychological phenomena.

If, while ourselves rejecting neural explanations of psychological action, we still seek a justification for the belief in such reputed explanations, we can find it in the overpowering impulse to make a rigid and fixed explanation of such utterly important and exceedingly difficult facts as psychological phenomena are. How vain is such a quest is clear from the fact that quite aside from its violation of scientific methodology (namely, to seek the cause of a phenomenon in a part of itself) we maintain, and with perfect safety we believe, that a genuinely critical search will reveal not a single valid principle of explanation which psychology has derived from physiology—although this does not deny, in any sense, that many valuable psychological principles were worked out by physiologists. In order not to be misunderstood at this point let us forthwith distinguish between the useful, nay, necessary employment of the neural factors as descriptive elements of actual reaction systems from the useless and pernicious employment of the neural apparatus as an explanatory process. We propose with all emphasis to distinguish between (1) the description of the exceedingly important part which the synaptic coördination processes as integrative functions play in every reaction system,⁶ and (2) the neural structures and functions which are implied to exist beside the psychological response and to explain it. In plainer words, let us distinguish between the facts which the neurologist and nerve physiologist have discovered and verified and the neural theories which the older psychologists have invented to materialize their psychism. Let it not be overlooked that we do not deny that in many cases the psychologists' imaginary neurology is based upon a germ of fact. A case in point is the elaboration of the neurological fact that the impulse meets with greater resistance at the synapse than in a nerve trunk, into the fiction that synaptic resistance is the cause or condition of such complex action as remembering or knowing. Such inventions consist primarily, of course, in the translation of associationistic mechanisms into neural terms.

It is all very well to desire fixed materials of references with which to secure complex phenomena, but as a matter of fact the nervous apparatus can not accomplish any such purpose, and pri-

⁶ Cf. our discussion of the reaction system in this JOURNAL, 1921, Vol. XVIII, p. 263.

marily, of course, because there does not exist any need to anchor down psychological facts when we consider such facts to be concrete responses to stimuli, as indeed they are. We cheerfully admit, as we have previously observed, that for extreme mentalists or spiritualists the neural mechanisms do serve as stable supports, but who, we might ask, would be willing to accept a type of psychology needing such support?

To test our proposition concerning the negative value of neural mechanisms in the interpretation of behavior we might consider the case of the child learning to keep his finger away from the burning candle. In particular, we might study Holt's neural interpretation, since this is one of the most recently formulated views based upon a mercilessly severe criticism of other neural explanations. After rejecting the Meynert scheme which James has made into a classic, Holt assumes that the child is endowed with two reflexes, one for extension and the other for retraction. Now the explanation consists in positing a greater "openness" and "wearing down" of the second or retractive path so that it will operate in preference to the first. But even if we agree to overlook entirely the absolutely hypothetical character of the "openness" and "wearing down" of paths, must we not assume, if the two reflexes are present, that both pathways are already open and worn down? Yet Holt finds it necessary to explain how the second or retraction path is opened and worn down relatively more. This explanation which he offers is twofold. In the first place, he asserts that the prolonged pain which the child suffers continues the retraction stimulus for a long period, thus causing the path to wear down. And in the second place, he suggests that just as the first five pedestrians across a snow-covered field do more than the next twenty-five toward making a path, so the passage of a first nervous impulse over a path of high resistance wears it down more than the same impulse would wear an already opened tract.⁷

As to the first point, what does Holt mean by pain? Not a mental something, let us hope. For if he does, he not only abjures the necessity for explaining anything, since by admitting mentalities he need merely associate with pain an "idea of retraction" as in the original Meynert scheme, but he also involves himself in the far worse situation that he can never demonstrate the connection between such a mental state and a nervous mechanism, to say nothing at all of how such a mental state can wear down a neural path. On the other hand, if he means a pain reaction, that is to say, a response in which the person discriminates pain, then the pain reaction clearly

⁷ *The Freudian Wish*, p. 69.

can be a stimulus to the child to learn to withdraw his hand from the candle flame. But in this case, of course, the learning consists of the acquisition of a complete reaction system and not the wearing down of a path in the nervous system.

And now let us examine the second part, namely, that the retraction path is worn down more because it is a new path. Here again it is difficult to see why the retraction path is new, since Holt assumes the two reflexes to be present. And as to establishing a balance between the two,⁸ in what sense is that learning to keep the finger out of the flame when in fact the balance means merely that both acts will be performed. That is to say, each time the child puts his finger into the flame he will also withdraw it. No, Holt must cleave to the notion of a greater openness of the second path, and not merely a balance between the two, but, even if we allow that the retraction path is new and that a new path is opened more at first, how is Holt's problem any nearer a solution? What more can happen with the retraction path than that it reaches the condition of the extension path when the latter first began to be used.

To us the entire explanation is exceedingly fantastic, and for the reason, we might suggest, that Holt is attempting to make the entire learning a neural affair,⁹ even to making the stimulating situation (the pain reaction) a factor in the neural process. Were it not for the faith in the neural theory as an explanatory mechanism it is doubtful whether both reactions would have been considered reflexes at all. Now if we are correct in assuming that Holt's handling of the neural theory is as effective as any, then we mean to suggest the possible incapacity of any of them to account for psychological facts.

Very differently is the learning explained on the organismic-response¹⁰ and stimulus basis. As a matter of fact, although it makes little difference for the explanation, we need not consider the first or extension act as a reflex. Be that as it may, we consider the act to be present and because the result is disastrous or unsatisfactory (painful) we observe a new act to be built up. We assume that the withdrawing action constitutes a new response built up for adaptation to the candle as a consequence of the previous reaction to that candle and in addition to the retraction reflex. In other words, there is a new behavior segment established in which the candle constitutes the stimulus. It is the acquisition of this reaction system which constitutes the learning.

⁸ *Ibid.*, p. 72.

⁹ At this point he is not living up to his promise in the criticism of neural theories.

¹⁰ The term organismic is used to point out the absolute inseparability of the stimulus and response factors in a psychological action.

We assume that in the second or new behavior segment, the child discriminates the stimulus differently or has developed a new meaning for the candle flame, a *new* meaning in the sense that a new differential response is called out by it. This is the essential fact in all perceptual activities. Instead of perceiving the object as something to touch, it is now something that hurts and must be (is) left alone. The essentially perceptual phase of the new behavior segment is a vestigial or incipient performance of the previous reaction, which precedes a final overt response—the withdrawal of the hand or some other mode of action. Especially must we guard here against any implication that the candle flame in the second behavior segment calls out an “idea” of the burn as in the Meynert-James scheme. No such factitious element is in any sense involved in our exposition. The strictly perceptual phase of the behavior segment is an act of the person in precisely the exact form as in the first instance. Moreover, the perceptual act is not in any sense merely a neural mechanism but a complete behavior, although it is true enough that it is not as open to the spectator’s observation as the first act. Also we must observe that in the candle-flame situation the perceptual act happens to be a visual response; that is to say, a reaction system in which the primary receptor is ocular, although the complete reaction system does involve in addition tactual factors. The new retraction act, then, is one in which the child’s contact with the candle is visual. In fact the importance of the new acquisition lies precisely in the avoidance of any actual touching of the object. But notice, however, that the learning may be just as effective if the new act involves auditory or olfactory perception. And finally, we must be very careful not to confuse the anticipatory perceptual reaction system with the final withdrawal or other response which follows closely upon the operation of the former.

The importance and value of our hypothesis as compared with any neural one, of which we take Holt’s to be an especially good example, is further indicated in the fact that it can accomplish two things which Holt admits his theory can not,¹¹ namely, (1) account for all kinds of learning and (2) explain the child’s concept of candle. As to the first, or the explanation of other kinds of learning, from our standpoint all learning, whether manual (handicraft), technical (skill, industrial or esthetic), or informational (book learning) consists of the organization of new behavior segments, that is, specific responses to specific stimulating objects or conditions. Each response constitutes the acquisition of a new specific adaptation to

¹¹ *The Freudian Wish*, p. 74.

particular surrounding objects. It is thus that capacities and information are acquired by the person.

Concepts, from our standpoint are completely implicit or vestigial responses to surrounding objects. In other words, they are the ordinary perceptual responses so abstracted from the original contact with things through the removal of the stimulating object, that they are aroused to action through a substitution stimulus.¹² Very simply explained, then, are the child's concepts of the candle; they are merely residual responses left over from the original contacts with the candle, and which can be translated into verbal terms. That concepts are derived from originally overt contacts with objects no one will deny, for it is a matter of course that the number and variety of our concepts depend upon our actual past experiences. Also, the degree of abstraction of our concepts depends upon whether our original contacts with the conceived objects were direct (actual) or indirect (imparted to us through speech or printed matter). Once more, unless concepts were implicit actions derived from our actual previous contacts with our stimulating objects, how could it ever be possible to react to these objects in their absence? To repeat, our concepts of objects are the reaction systems developed to those things, which can function relatively independently of them.¹³

Some there are who will still persist in the criticism that after all the organismic hypothesis affords us no intimation as to why reaction systems are built up as responses to stimulation objects. In considering this criticism two points must be carefully distinguished, one of which has no answer. If one means by this criticism that we have not specified why it is that any empirically specific response is developed to a particular stimulus, we might answer that in our argument we assumed that any given stimulating situation would necessarily call out an adaptive reaction correlated with that situation; since, further, we fundamentally assume that psychological reactions are phenomena of adaptation. But observe that the stimulating situations are not the exclusive conditions for the building up of particular reactions. Another very important set of conditions is found in the previous psychological development of the organism, and a by no means negligible circumstance is the biological organization of the individual. Nor do all of these in their aggregate exhaust the conditions for the acquisition of reaction systems; there are many others if only we devote ourselves to a study of psychological phenomena under the factual conditions of their development and occurrence. Most fortunate the day when

¹² Cf. Kantor, "An Objective Interpretation of Meanings," *Am. Jour. Psy.*, 1921, Vol. XXXII, pp. 231 sq.

¹³ Through substitution of stimuli, as we have said above.

psychologists will give up the ideas that psychological phenomena are simple or that they can be reduced to such partial explanatory terms as are involved in the nervous mechanism. Observe, however, that whatever explanation there be for the acquisition of our particular reactions, it can not exist otherwise than in the study of concrete behavior segments.

On the other hand, if one takes the import of the criticism we have mentioned to be that we do not know how reaction systems are built up at all, we can only question the legitimacy of the question. We take it that we are no more obliged to explain why psychological organisms have their specific properties (for we may assume the fact of building up reaction systems as a quality of the organism) than the physicist is required to explain why bodies fall. Not that we would restrict any speculation based upon fact and the criteria of logic, but we do insist that whatever we believe and assert concerning psychological phenomena must be in accord with observable fact and in harmony with the logic of science. In point of fact, is it not obvious that the criticism just discussed is urged entirely in the interest of a neural explanation, which we of course take to be something different from a psychological description?

Next to the misinterpretation of the entire reaction, by far the greatest damage sustained by psychology from the neuron theory is the retardation in the understanding of the actual function of the neural factors of reaction systems. If it is true, as we believe, that in much of current psychological work an erroneous use of the nervous apparatus is made, then it appears plausible that we are not acquiring all the information we should concerning the actual operation of that important component of all reactions. Surprisingly little is yet known of the exact workings of the neural mechanisms, and since numerous are the facts to be known it therefore behooves us to let no false hypothesis prevent us from investigating neural mechanisms as actual phases of behavior, that is to say as exceedingly complex coördinating systems, and not as causes of acts or counterparts of invented mentalities.

Not untrue is it to say, then, that the organismic hypothesis is presented in the interest of an emended conception of the relationship between psychology and biology. Instead of considering biological phenomena as merely explanatory schemes for psychology,¹⁴ we must study the physiological facts with which psychology is concerned as actual and essential components of a larger adaptation process, namely, the psychological response. No latitude is

¹⁴ The reader will recall that among the first achievements of "biological psychology" was the redefinition of "consciousness" as a thing or process developed to maintain the life of animals.

allowed us in this matter at all, and we dare not omit any physiological fact, because it is just a fact of nature that all psychological organisms are biological organisms also. This truth, of course, should offer no inducement to the psychologist to use physiological facts or fables to explain the phenomena of his scientific domain. Nor is this evil necessary in any sense when we study psychological responses as definite autonomous events existing in nature. Of course, if we consider the phenomena of psychology to be correlates or adjuncts of physiological facts we must frequently resort to the magical use of the nervous system. But regardless of how easily the words cortical and cerebral roll from the tongue of the psychologist when he wishes to explain some mentalistic fact,¹⁵ the neurologist still can not find in the cortex any of the magical conveniences which the psychologist requires.¹⁶ For example, there has never been any neural machinery discovered to account either for the existence or the association of mentalistic ideas.¹⁷

Finally, we must not be misled by the overlapping of some of the psychological data with biological facts into distorting such data by the indulgence in general physiological explanations; for in the first place, psychological phenomena are no more physiological than they are physical, and in the second place, the argument that psychology is based on physiology is no more valid than the argument that all sciences, because they are human phenomena, are based upon sociology. The only valid scientific procedure is to accord full recognition to any facts that we study without attempting violently to transform them into something else.

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BOOK REVIEWS

Christianisme et Neo-Platonisme dans la Formation de Saint Augustin. CHARLES BOYER. Paris: Gabriel Beauchesne. 1921.

L'Idée de Vérité dans la Philosophie de Saint Augustin. CHARLES BOYER. Paris: Gabriel Beauchesne. 1921. Pp. 233.

We have bracketed these two treatises, not merely because they

¹⁵ An explanation that frequently takes the form of thinking that specific brain cells are connected in some way with particular thoughts.

¹⁶ In similar fashion when the physiologist hits upon some fact which the mere study of neural mechanism does not and can not explain he utters the magic word "consciousness."

¹⁷ Cf. Herriek, *Introduction to Neurology*, 1920, Ch. 20. While we can not accept in the slightest Bergson's metaphysical substitution for the neuron theory (*cf. Matter and Memory*) we must nevertheless commend his excellent exposure of the defects of that theory.